

# **AURAL DIVERSITY**

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## **HEARING DIFFERENCES**

"Disabilities", "disorders", "impairments", "loss" etc. affect 1 in 6 people and are typically classified on an audiometric scale from profound deafness to mild hearing loss. But differences are more prevalent than that.

Less than 17% of people in Europe meet the international standard for "normal" hearing Deaf (big D) = primarily communicates through sign language. deaf (small d) = does not sign. Hearing may be through interpretation. Hearing loss may be present from birth or acquired, in one or both ears, but n.b: not all forms of hearing difference involve loss.

**MIXED** 

CONDUCTIVE

Genetic, age-related, noise-related,

drugs, disease, trauma, ear wax,

infections auditory system, etc.

**Tinnitus** 

Perception of sound when

no sound is present. May be

subjective, objective or

pulsatile. Often involves

clicking, buzzing, hissing

or roaring sounds.

Auditory

**Processing** 

Disorder

"Normal" hearing, but

sound cannot be

processed by the

brain.

**AUDITORY** 

**SYSTEM** 

Neurological differences

that affect hearing

**SENSORINEURAL &** 

### Genetic

Inherited but not necessarily present from birth. Caused by mutation of

dominant, recessive or mitochondrial genes.

## Congenital

Present from birth. May be hereditary or caused by drugs, viruses or syndromes

#### Acoustic Shock

Caused by inexpected loud sounds.

**Auditory** 

**Neuropathy** 

Ear detects sound but

has trouble passing it

to the brain.

## Disease

Viral, bacterial,

fungal infections, diabetes, meningitis, tumour, inflammatory,

**SENSORINEURAL** 

c. 90% of all hearing loss.

**Ototoxic** 

Caused by drugs.

ncludes cochleotoxicity

and vestibulotoxicity

(one or two-sided)

Inner ear or nerve problems.

Ménière's etc.

### Other **Causes**

e.g. stroke, head trauma, perinatal conditions. hypothyroidism,

cancers etc.

#### **Amusia**

Noise-induced

Caused by one brief

intense sound or

continuous exposure

to loud sounds.

Inability to perceive or produce musical sounds. Congenital or acquired (a.k.a. "tone deaf").

Recruitment

Reduced tolerance

of loudness.

### **Phonophobia**

Fear of specific sounds.

Negative emotional reactions to certain trigger sounds.

Misophonia

### "NORMAL" HEARING

**Hallucinations** 

Musical (hearing music

when none is present);

hearing voices etc.

defined by the International Standards Organisation as: "otologically normal persons in the age range from 18 years to 25 years inclusive" (ISO 226:2003) i.e. around 17% of the population.

#### **Foetal hearing**

A foetus's hearing is fully formed and functional from the last trimester of pregnancy.

#### Infant hearing

It typically takes six months for babies' hearing to develop to the point that they can fully hear and understand a range of sounds.

#### **Blockages**

Caused by wax, fluid, narrrow canal. abnormal bone growth tumours, cholesteatoma

#### Barotrauma

Unequal air pressure between external and middle ear.

### **CONDUCTIVE**

Problems sending sound waves through the ear.

#### **Inflammations**

Caused by viral, bacterial, fungal infections, allergies. otitis. Eustachian tube dysfunction, etc.

## **Palinacusis**

Sounds repeat after inaudibility.

## **Diplacusis**

Perception of pitch differences between the two ears.

#### Hyperacusis<sup>°</sup> Increased

sensitivity to sound

## **Neurodivergence**

Autistic people often have heightened sound perception and an ability to focus on detail.

professional ear training for e.g. engineers.

### **Natural**

bacterial or fungal infections, common e.g pinna shapes cold, tiredness individual.

#### Historical

e.g. past differences in hearing, evidenced by hearing aids.

## Geographical

e.g. regional patterns of hearing loss.

### Cultural

e.g. d/Deaf

culture.

**Temporary** 

e.g. wax, viral,

Enlarged Vestibular Aqueduct; Labyrinthine Fistula; Superior Canal Dehiscence.

Inner ear

**Hearing Aids** Amplification devices. Behind-the-ear (BTE), In-the-ear (ITE), In-the-canal (ITC) Right-In-the-Ear (RITE) and others use acoustic waves. Bone-Conduction HA use

mechanical waves to carry the signal to the cochlea. Contralateral Routing of Signals (CROS) aids transmit auditory information from one ear to the other.

### **Implants** Surgically implanted

Cochlear

neuroprostheses which bypass acoustic hearing by direct electromagnetic wave stimulation of the auditory nerve.

#### Ears Trained

Auditory (re-)training, and musicians, linguists, doctors,

unique to every

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**VARIATIONS** 

Non-cochlear e.g. touch. vibration, textual,

## **Ethnic**

e.g. prevalence of hearing loss varies across ethnic groups.

#### **Environmental**

e.g. noise exposure, e.g. disparities as lifestyle issues, etc. a determinant of hearing health

## ANIMAL HEARING

**Economic** 

Humans hear 20Hz-20kHz whereas bats hear  $^{\circ}$ 9 kHz-120 kHz and mice hear 1 kHz to 70–90 kHz. Pigeons hear infrasound (down to 0.5Hz). Dolphins, rats, horses, cats, dogs, elephants, owls, moths and many other species have specially adapted hearing which far exceeds human capabilities.

#### Other **TECHNOLOGY Devices** e.g. hearables,

smart earbuds, assistive listening, apps, etc.

#### Machine Listening a.k.a. Computer

Audition, a branch of Al and computer science.

## **ACOUSTICS ENGINEERING**

Includes many fields that affect aural diversity.

### Adults to old age

Hearing deteriorates throughout life at varying rates from person to person. Male hearing typically declines at twice the rate of female hearing. Age related hearing loss (or presbycusis) may also be worsened by external factors such as environmental and medical conditions. High frequencies are lost first, and this usually becomes noticeable at c. 40 years, when our hearing range starts to dip below 14kHz. We may have difficulty understanding speech and distinguishing sounds in crowded noisy places. We may need to raise volume levels, ask people to repeat themselves, or experience tinnitus.

#### Teens/young adults The normal hearing frequency range of a healthy young person is

about 20 to 20,000Hz. A 'normal' audible range for loudness is 0-180dB SPL. Anything over 85dB SPL risks damaging hearing.